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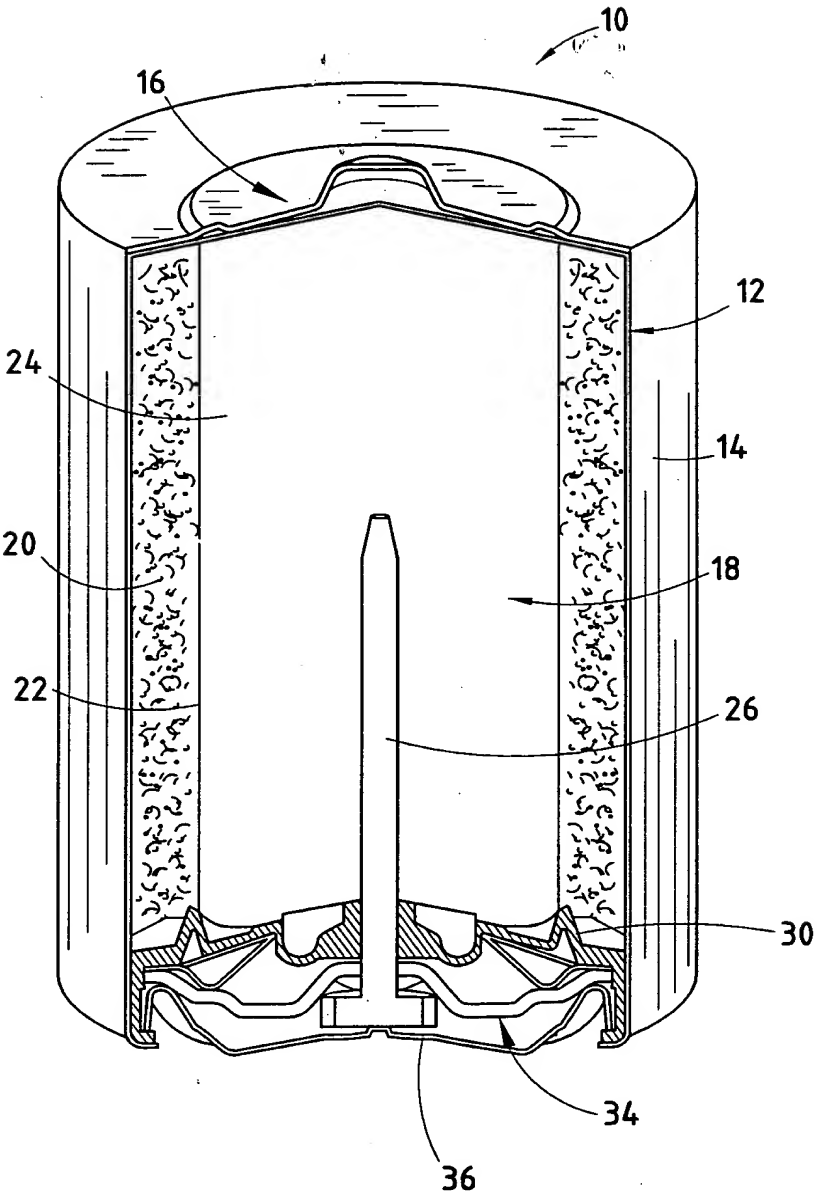

FIG. 1

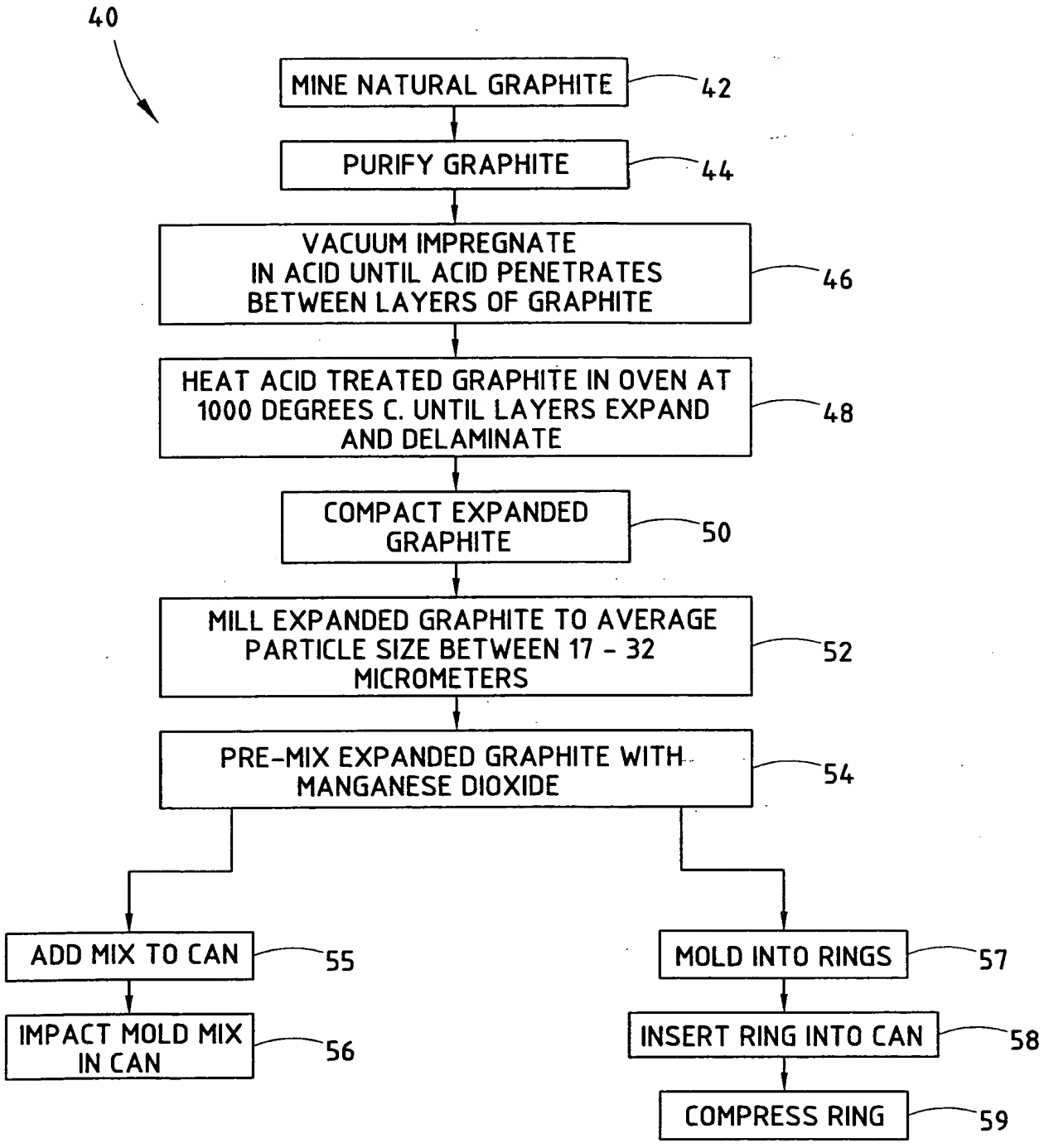
40
MINE NATURAL GRAPHITE
42
PURIFY GRAPHITE
44
VACUUM IMPREGNATE IN ACID UNTIL ACID PENETRATES BETWEEN LAYERS OF GRAPHITE
46
HEAT ACID TREATED GRAPHITE IN OVEN AT 1000 DEGREES C. UNTIL LAYERS EXPAND AND DELAMINATE
48
COMPACT EXPANDED GRAPHITE
50
MILL EXPANDED GRAPHITE TO AVERAGE PARTICLE SIZE BETWEEN 17 - 32 MICROMETERS
52
PRE-MIX EXPANDED GRAPHITE WITH MANGANESE DIOXIDE
54
ADD MIX TO CAN
55
IMPACT MOLD MIX IN CAN
56
MOLD INTO RINGS
57
INSERT RING INTO CAN
58
COMPRESS RING
59

FIG. 2

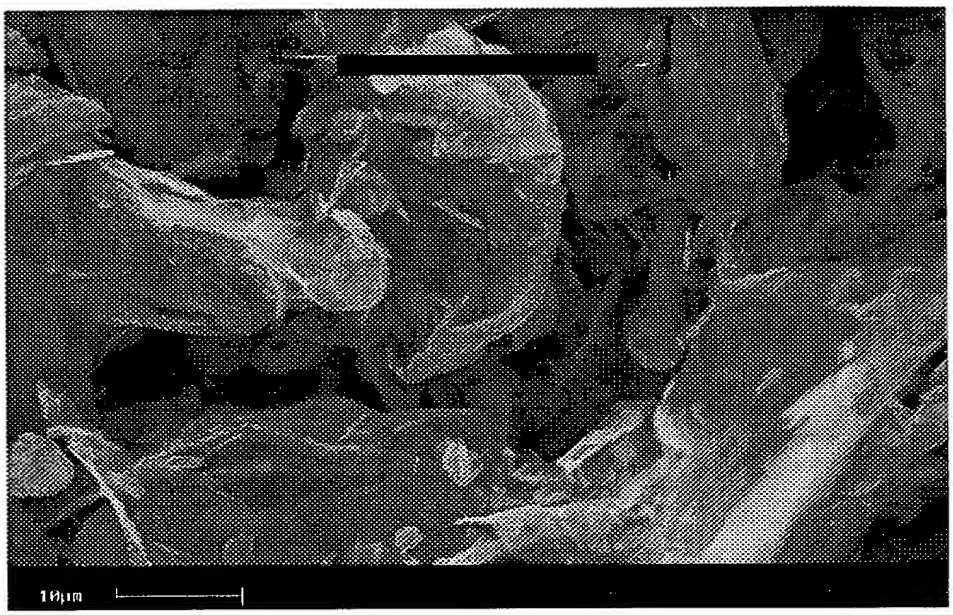

FIG. 3

PERFORMANCE ANALYSIS

Expanded Graphite	Service# to 0.9V	Microtrac Particle Size (μm) d_{10}	d_{50}	d_{90}	mv♦	ma*	BET Surface Area	Kerosene Abs.	Pellet Resist.@	%Water (110°C)	Scott Density	Real Density	Surface Area (calc.)	Bulk Volume	Tap Density
S1	97.1	4.96	19.61	43.18	27.51	13.35	26.7	2.74	1.78	0.16	0.04	2.30	0.450	0.031	0.11
S2	90.6	4.26	16.51	48.27	29.88	12.20	18.1	2.06	1.19	0.12	0.06	2.28	0.492	0.043	0.14
S3	86.9	3.66	15.36	43.35	25.70	10.85	19.9	1.94	1.35	0.13	0.05	2.27	0.553	0.046	0.15
S4	66.0	3.13	9.23	15.50	10.31	7.73	9.6	1.36	3.44	0.03	0.07	2.26	0.776	0.069	0.22
S5	51.7	5.84	19.51	36.71	23.67	16.15	5.7	1.44	6.17	0.05	0.11	2.25	0.372	1.105	0.28
S6	65.2	3.37	10.42	16.36	11.59	8.93	8.2	1.37	4.16	0.05	0.07	2.27	0.672	0.068	
S7	77.0	20.69	81.60	160.21	110.02	45.80	21.3	4.39	1.61		0.06	2.25	0.139	0.034	0.10
S8	93.0	6.53	21.33	58.07	31.74	14.90	23.1	3.51	0.84		0.04	2.30	0.403	0.034	0.11
S9	90.0	4.72	20.42	16.62	44.25	13.60	21.5	2.78	1.08		0.05	2.27	0.441	0.042	0.12
S10	72.3	4.72	9.93	18.18	11.05	8.22	8.4	1.25	4.37	0.06	0.08	2.25	0.730		0.23
S11	71.9	9.74	19.89	41.93	24.11	16.86	4.5	1.35	7.99	0.10	0.11	2.25	0.356		0.28
S12	82.7	10.91	35.06	118.67	54.92	23.26	13.7	2.60	1.47	0.10	0.10	2.24	0.258	0.057	
S13	93.1	7.48	23.65	73.09	35.2	15.93	22.4	2.77	0.76	0.09	0.10	2.25	0.377	0.035	0.11
S14	77.0	8.99	29.64	82.39	40.8	19.17	18.4	3.52	1.33	0.08	0.05	2.28	0.313	0.039	0.12
S15	86.0	8.98	28.80	77.24	37.95	18.89	20.0	3.47	1.14	0.08	0.05	2.27	0.318	0.038	
S16	85.0	9.04	29.96	85.26	41.76	19.33	18.4	3.20	1.35	0.01	0.05	2.27	0.310	0.039	
S17	76.0	8.99	34.48	94.09	46.43	22.23	18.3	4.38	1.56	0.11	0.06	2.29	0.270		0.11

with 20:1 O:C ratio, 100 mA/g EMD ♦mv=mean diameter of volume *ma=mean diameter of area @ with 20:1 O:C ratio, fully relaxed

FIG. 4

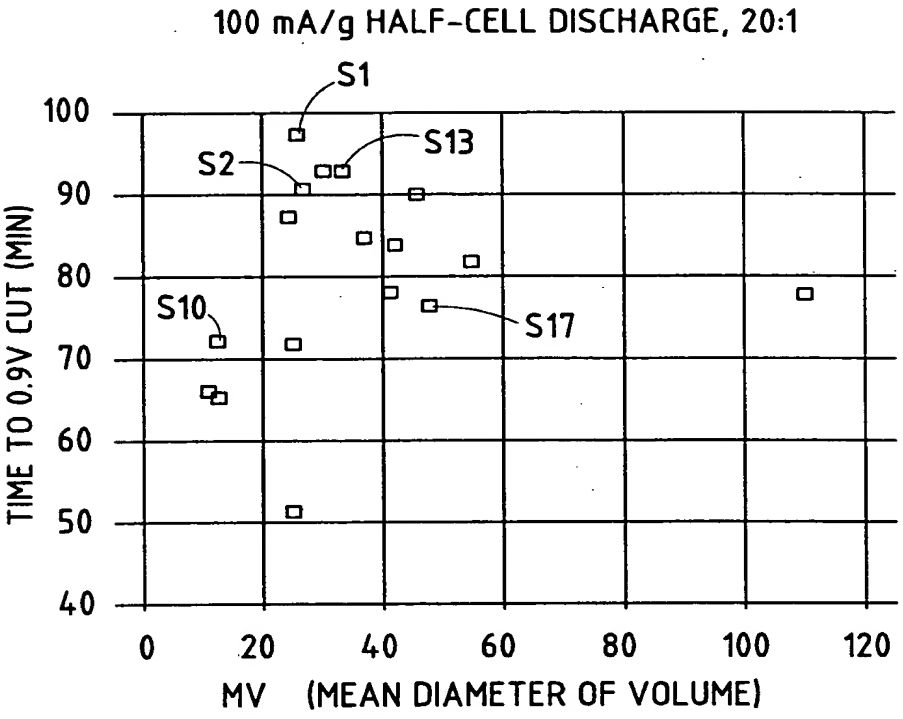
100 mA/g HALF-CELL DISCHARGE, 20:1
S1
S2
S13
S10
S17
TIME TO 0.9V CUT (MIN)
100
90
80
70
60
50
40
0
20
40
60
80
100
120
MV (MEAN DIAMETER OF VOLUME)

FIG. 5

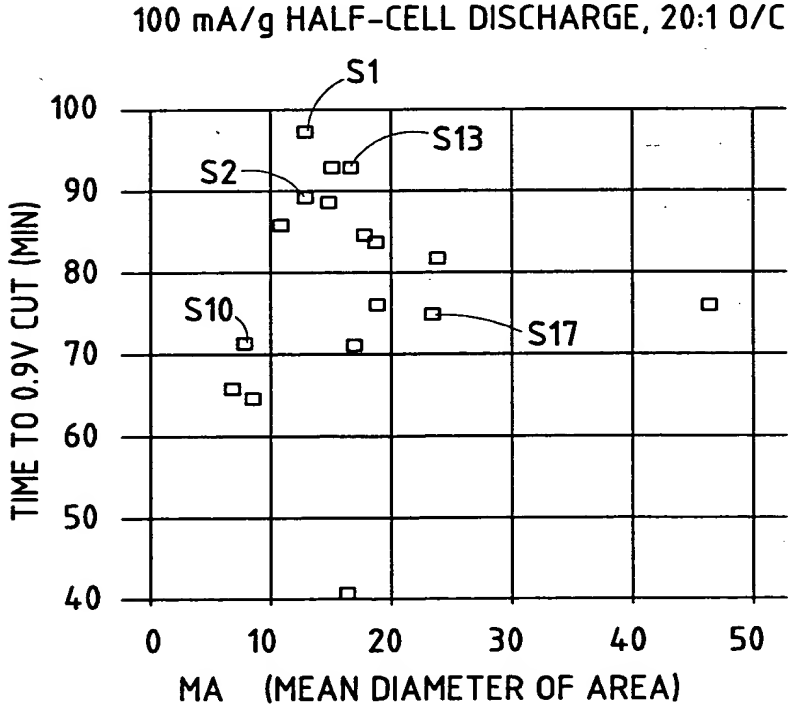
100 mA/g HALF-CELL DISCHARGE, 20:1 O/C
S1
S2
S13
S10
S17
TIME TO 0.9V CUT (MIN)
100
90
80
70
60
50
40
0
10
20
30
40
50
MA (MEAN DIAMETER OF AREA)

FIG. 6

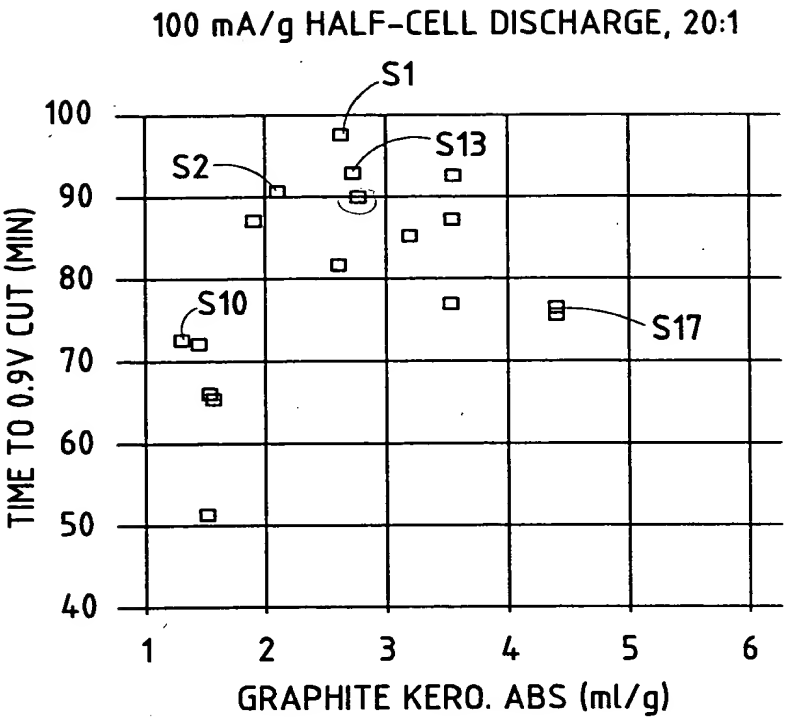
100 mA/g HALF-CELL DISCHARGE, 20:1
S1
S13
S2
S10
S17
100
90
80
70
60
50
40
TIME TO 0.9V CUT (MIN)
1
2
3
4
5
6
GRAPHITE KERO. ABS (ml/g)

FIG. 7

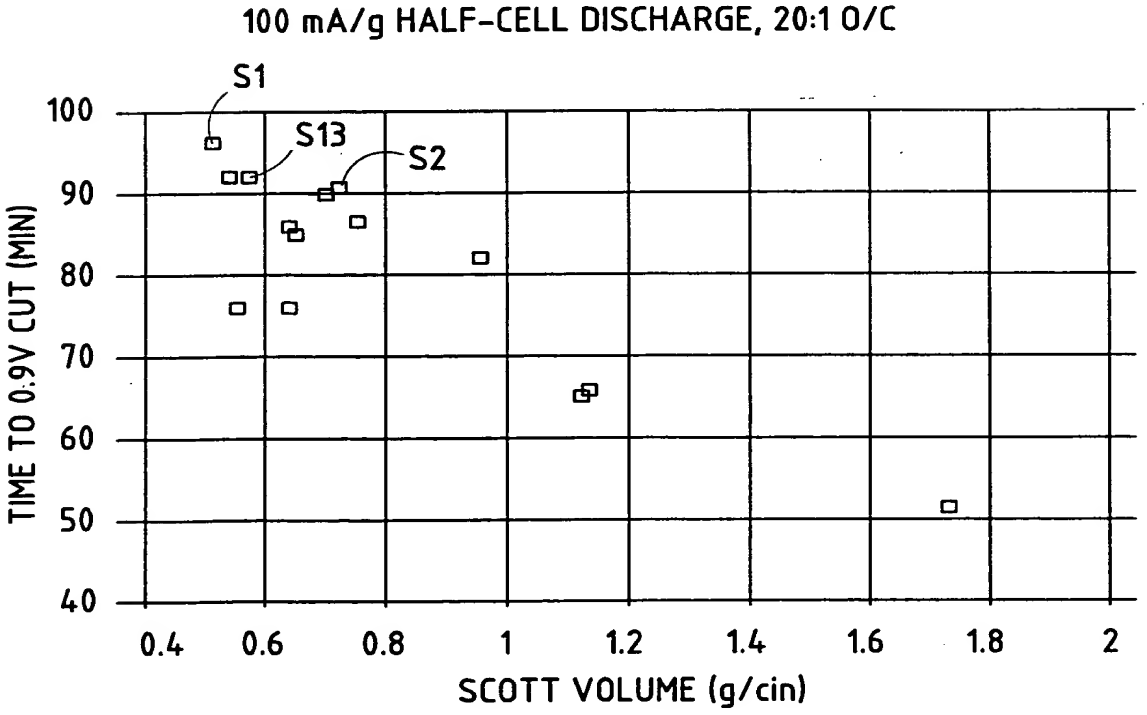
100 mA/g HALF-CELL DISCHARGE, 20:1 O/C
S1
S13
S2
100
90
80
70
60
50
40
TIME TO 0.9V CUT (MIN)
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
SCOTT VOLUME (g/cin)

FIG. 8

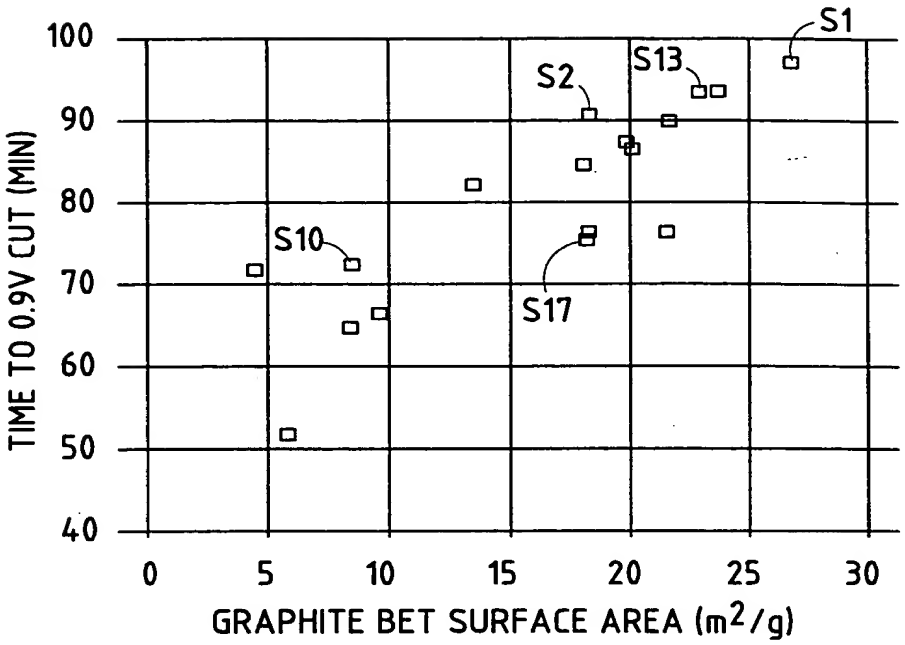
100 mA/g HALF-CELL DISCHARGE, 20:1
TIME TO 0.9V CUT (MIN)
100
90
80
70
60
50
40
0
5
10
15
20
25
30
GRAPHITE BET SURFACE AREA (m2/g)
S1
S2
S13
S10
S17

FIG. 9

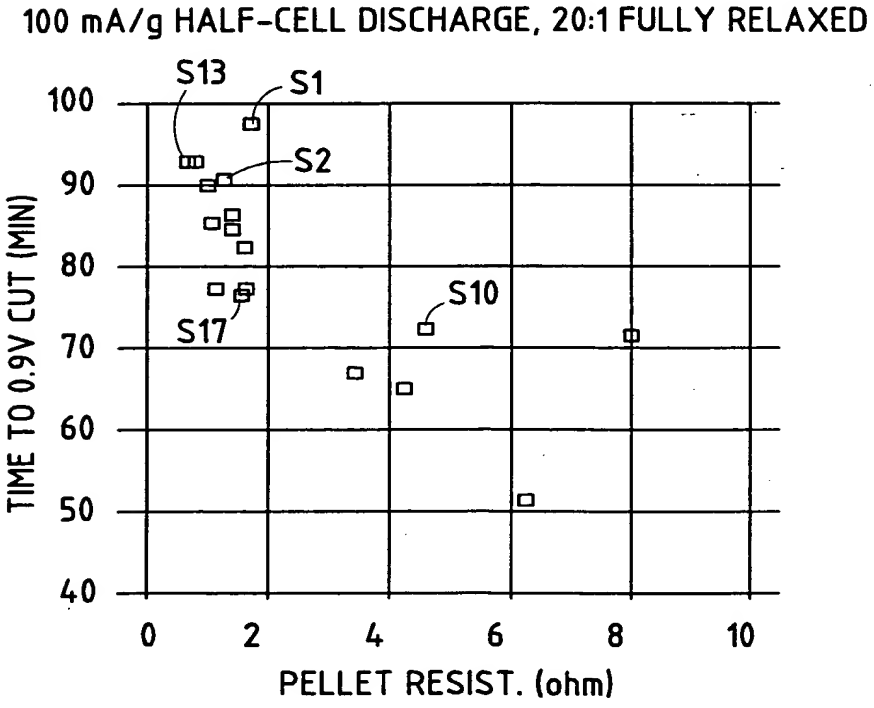
100 mA/g HALF-CELL DISCHARGE, 20:1 FULLY RELAXED
TIME TO 0.9V CUT (MIN)
100
90
80
70
60
50
40
0
2
4
6
8
10
PELLET RESIST. (ohm)
S13
S1
S2
S10
S17

FIG. 10

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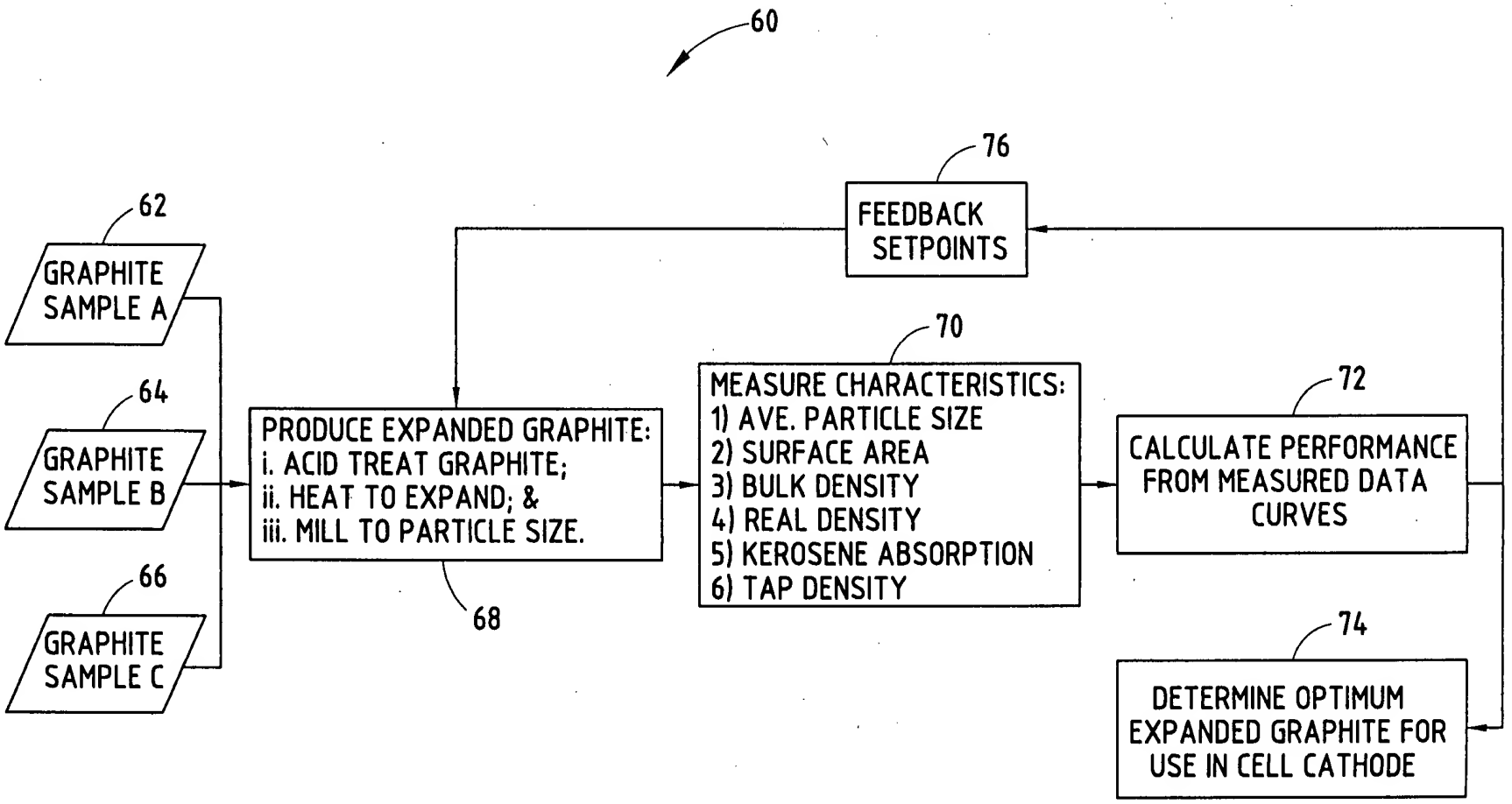

FIG. 11

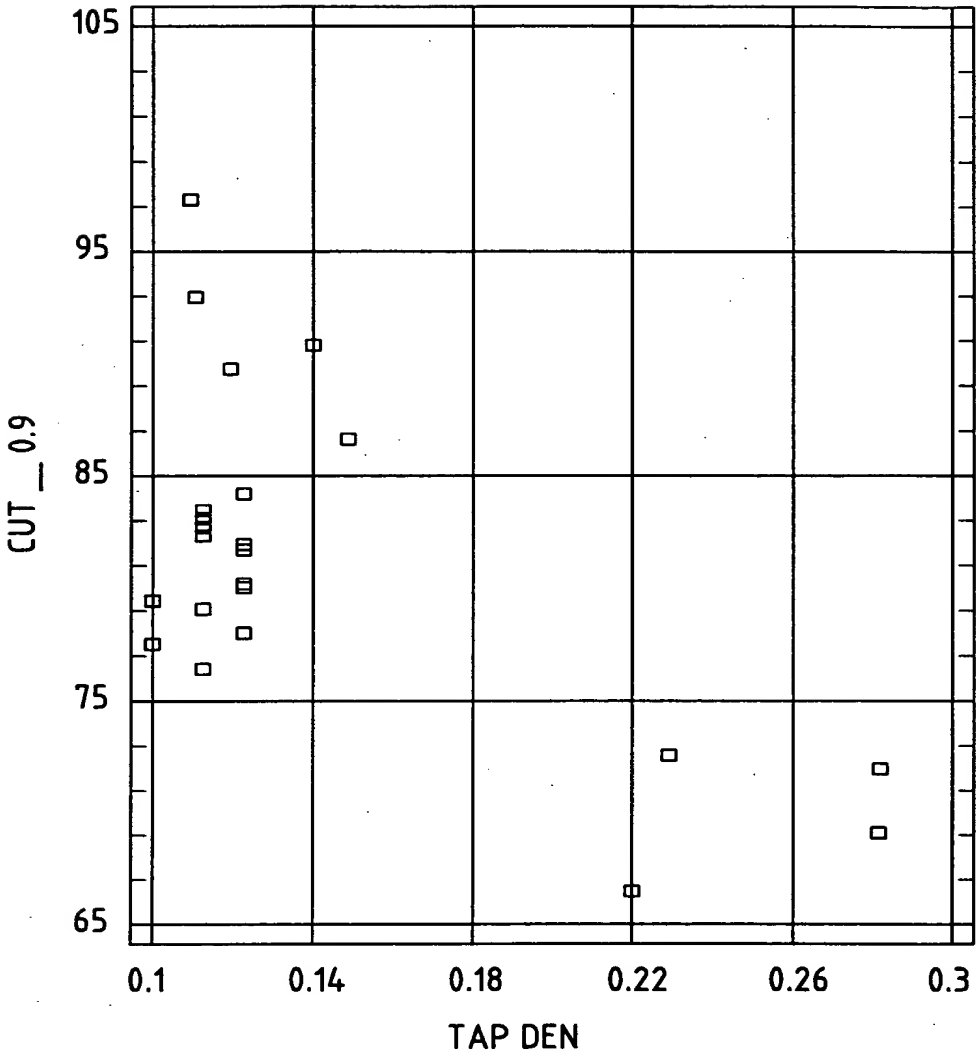

FIG. 12